REMARKS

The Office Action dated December 1, 2004, has been received and carefully noted. The above amendments, and the following remarks, are submitted as a full and complete response thereto.

Claims 5 and 10 are amended to more particularly point and distinctly claim the subject matter of the invention. Claims 13 and 15-17 are cancelled without prejudice. No new matter has been added by the amendments, and no further search and/or consideration is needed. Thus, claims 1-12 presently are pending in the application, and are respectfully submitted claims 1-12 for consideration.

Claims 5-8 and 10-12 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 4,879,077 (Shimizu et al.) in view of U.S. Patent No. 4,540,359 (Yamazaki). The Office Action referred back to the position taken in a previous Action that Shimizu taught all the elements of claims 5-8 and 10-12 except that "Shimizu does not show moving the screw backwards while rotating it after completion of the measuring process or the injection process." Yamazaki was cited as providing the elements of the claims missing from Shimizu. The Office Action also noted that "Shimizu does not explicitly define an arbitrary synchronization ratio," but alleged that this feature is nonfunctional descriptive material. Applicants respectfully traverse the obviousness rejection and submit that the cited references, either alone or in combination, do not disclose or suggest all the features of any of the presently pending claims.

Claim 5, upon which claim 6 is dependent, recites a method for controlling an injection molding machine in order to perform a resin plasticization/measuring process and an injecting process. The injection molding machine includes a heating cylinder and a screw having a flight of a pitch P. The screw is arranged within the heating cylinder. The method includes defining a synchronization ratio S with reference to a rotation speed R and a constant linear backward speed V of the screw. The synchronization ratio S is equal to 100% when the flight does not apparently move while the screw is rotated and linearly moved backwards. The synchronization ratio S is smaller than 100% when the flight moves backwards while the screw is rotated and linearly moved backwards. The synchronization ratio S is greater than 100% when the flight moves forwards while the screw is rotated and linearly moved backward. The method also includes controlling the screw to linearly move backward at a selected synchronization ratio Sx and simultaneously rotate after completion of the plasticization/measuring process or the injecting process. A selected rotation speed Rs of the screw is given by: $Rs = (V/P) \times Sx$.

Claim 7, upon which claim 8 is dependent, recites a method for controlling an injecting molding machine in order to perform a resin plasticization/measuring process and injection process. The injection molding machine includes a heating cylinder, a screw having a flight of a pitch P and arranged within the heating cylinder, a first driving source for driving the screw in an axial direction, a second driving source for rotating the screw, a position detecting device for detecting an axial position of the screw, a rotation-

speed detecting device for detecting the rotation speed of the screw, and a controller for controlling the first and the second driving sources in response to detecting signals transmitted from the position detecting device and the rotation-speed detecting device. The method includes defining a synchronization ratio S with reference to a rotation speed R of the screw and a constant linear backward speed V of the screw. The synchronization ratio S is equal to 100% when the flight does not apparently move while the screw is rotated and linearly moved backwards. The synchronization ratio S is smaller than 100% when the flight moves backwards while the screw is rotated and linearly moved backwards. The synchronization ratio S is greater than 100% when the flight moves forwards while the screw is rotated and linearly moved backwards. The method also includes controlling the movement so that the screw is linearly moved backward at a selected synchronization ratio Sx and simultaneously controlling the rotation of the screw, after completion of the plasticization/measuring process or the injecting process. A selected rotation speed Rs of the screw is given by $Rs = (V/P) \times Sx$.

Claims 10-12 depend from claim 9. Claim 9 recites a method for controlling an injection molding machine in order to control the movement of a molten resin in a heating cylinder of the injection molding machine. The injection molding machine includes a screw arranged within the heating cylinder to be rotatable and to be linearly movable, and having a flight of a pitch P. The molten resin is moved in a forward feeding direction during a plasticization process and an injecting process. The method includes the step of linearly moving the screw backwards relative to the forward feeding

direction of the molten resin at a constant backward speed and simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed, after completion of the plasticization process or the injecting process.

Dependent claim 10, upon which claims 11 and 12 are dependent, includes the features of claim 9 discussed above, but also recites, when the screw linearly moves backward, controlling the screw to move at a linear backward speed V and a rotation speed R in the forward feeding direction to define a synchronization ratio S based on the rotation speed R of the screw and the linear backward speed V of the screw. The synchronization ratio S is equal to 100% when the flight does not apparently move while the screw is rotated and linearly moved backwards in the forward feeding direction. The synchronization ratio S is smaller than 100% when the flight moves backwards while the screw is rotated and linearly moved backwards in the forward feeding direction. The synchronization ratio S is greater than 100% when the flight moves forwards while the screw is rotated and linearly moved backwards in the forward feeding direction.

As discussed in the specification, examples of the present invention enable the screw to be moved backward at the constant speed V after completion of the plasticization/measuring process or the injecting process. The rotation speed R of the screw during the backward movement is controlled based on the equation $R=(V/P) \times Sx$. In the injection molding machine, after completion of the plasticization/measuring process or injecting process, the molten resin pressure at the nose portion of the screw is

increased because of the back pressure caused in the process. If the mold is opened in the state of a high molten resin pressure at the nose portion of the screw, then the molten resin leaks from the runner of the mold. Thus, after completion of the injecting process, the high molten resin pressure caused by the above-described processes remains in the nose portion of the screw. In order to precisely control the back pressure in the above-described processes, examples of the present invention reduce the high molten resin pressure caused in the plasticization/measuring process or the injection process. Subsequently, the control of the back pressure is performed under reduced molten resin pressure, for example, in the reset state. In the above-described processes, however, when the screw is only moved backwards without the rotation thereof, the resin also is likely to be dragged backwards together with the flight because the resin is applied to the flight of the screw. As a result, a uniform distribution of the volume and density of the resin is hampered at the nose portion of the screw without the features described by the examples of the present invention. As discussed in the specification on page 4, lines 6-10, the lack of uniform distribution may lead to "a nonuniform weight of the molded products."

Thus, according to examples of the present invention, as the high molten resin pressure caused by the plasticization/measuring process or the injecting process reduces, the density distribution of the molten resin in the heating cylinder, particularly at the nose portion of the screw, may be sufficiently controlled. Further, the backward operation of the screw is performed by the use of the servomotor for injection while the rotation

operation of the screw is performed by the use of the servomotor for the rotation. It respectfully is submitted that the cited references, either alone or in combination, do not disclose or suggest all the features of any of the presently pending claims. Therefore, the cited references do not provide the critical and unobvious advantages described above.

Shimizu relates to a control method of an injection molding machine. Shimizu describes that a screw 2 is rotated in the reverse direction to the rotational direction in the measuring process at the same time when screw 2 is moved forward in the injection process. The apparent position of ridge 2h or groove 2d of screw 2 is set to become stationary in a predetermined position in the heating cylinder. Shimizu also describes calculating a reverse rotational speed, or r, of screw 2 using the equation $r \geq Vs/L$, where Vs is the injection (forward moving) speed of screw 2 and L is the pitch of screw 2.

Yamazaki relates to an injection molding machine, where a clamping mechanism and an injection mechanism are operated by the same electric motor. Yamazaki describes injection screw 20 being rotated clockwise to forwardly feed under pressure the resin from hopper 43. As the molten resin increases, injection screw 20 is withdrawn by resin pressure while being rotated. Injection screw 20 has its rear portion rotatably connected to movable member 25 through extended shaft 26. Movable member 25 is moved together with injection screw 20 and gear 28, with a withdrawing force being applied to moveable member 25.

Applicant submits that the cited references, either alone or in combination, do not disclose or suggest all the features of the presently pending claims. For example,

applicant submits that the cited references do not disclose or suggest "controlling the screw to linearly move backward at a selected synchronization ratio Sx and simultaneously rotate after completion of the plasticization/measuring process or injecting process," as recited in claim 5. As noted previously, claim 7 recites "controlling the movement so that the screw is linearly moved backward at a selected synchronization ratio Sx and simultaneously controlling the rotation of the screw." Further, claim 10 recites "when the screw linearly moves backward, controlling the screw to move at a linear backward speed V and a rotation speed R in the forward feeding direction to define a synchronization ratio S based on the rotation speed R of the screw and the linear backward speed V of the screw." Applicant respectfully submits that the cited references, either alone or in combination, do not disclose or suggest at least these features of the presently pending claims.

Applicant submits that neither Shimuzu nor Yamazaki discloses nor suggests controlling the screw to linearly move backward at a selected synchronization ratio. Applicant submits that screw 2 of Shimizu and injection screw 20 of Yamazaki are not controlled while moving backward, as discussed above. Shimizu describes backward movement of screw 2, but does not disclose or suggest controlling the backward movement. Yamazaki describes movement of screw 20 using back pressure of the resin, but not controlling the screw to linearly move backward at a selected synchronization ratio.

As discussed above with regard to claims 5 and 7, it is described that the screw is linearly moved backwards while rotating it after completion of the plasticization/measuring process or the injecting process, and the selected rotation speed RS of the screw is controlled based on the equation $Rs = (V/P) \times Sx$. As stated in the Office Action, Shimizu "does not show moving the screw backwards while rotating it after completion of the measuring process or the injection process." Thus, as the high molten resin pressure caused by the plasticization/measuring process or the injection process reduces, Shimizu does not disclose or suggest the density distribution of the molten resin in the heating cylinder, particularly at the nose portion of the screw, may be sufficiently controlled. Applicant submits Shimuzu, for at least these reasons, does not disclose or suggest controlling the density distribution of the molten resin at the nose portion of the screw by reducing the high molten resin pressure caused by the plasticization/measuring process or the injecting process.

With regard to Yamazaki, this reference, either alone or in combination with Shimuzu, does not disclose or suggest at least the features of controlling the screw to move at a linear backward speed V and a rotation speed R in the forward feeding direction to define a synchronization ratio. As discussed above, Yamazaki describes the molten resin being accumulated with the nose portion of the injection screw 20 by the rotation of the injection screw that is driven by the servo motor 40. During the rotation of injection screw 20, injection screw 20 retreats backward by the retreat movement force caused by the back pressure of the molten resin. The retreat movement force of

Yamazaki also serves as the rotation force to threaded shaft 23. The rotation of threaded shaft 23, however, is restricted by back pressure control device 29 having the hysteresis brake through rotary shaft 24, so that the back pressure is controlled.

Unless the density of the molten resin is high enough to exceed the friction resistance force caused by the mechanical parts, such as injection screw 20 or threaded shaft 23, Yamazaki may experience increased difficulty in obtaining the retreat movement force of injection screw 20 because injection screw 20 of Yamazaki retreats backward by the back pressure of the accumulated resin. Thus, applicant submits that this aspect of Yamazaki does not disclose or suggest controlling the density distribution of the molten resin at the nose portion of the injection screw as the high molten resin pressure caused by the plasticization/measuring process or the injection process is reduced.

Applicant also submits that dependent claims 6, 8 and 11-12 are not disclosed or suggested for the reasons given above and because these claims recite additional subject matter. It is therefore submitted that, for the reasons and distinctions discussed above, the cited references do not disclose or suggest controlling the screw to move at a linear backwards speed V and a rotation speed R in the forward feeding direction to define a synchronization ratio S. Thus, the cited references, either alone or in combination, do not disclose or suggest all the features of claims 5-8 and 10-12. Applicant respectfully requests that the obviousness rejection of claims 5-8 and 10-12 be withdrawn.

Claims 1-4, and 9 were rejected under 35 U.S.C. § 103(a) as allegedly rendered obvious by Shimuzu in view of Japanese Patent No. JP 61-121921 (Akira). The Office Action took the position that Shimizu taught all the features of claims 1-4 and 9 except that "Shimizu does not show moving the screw backwards while rotating it after completion of the measuring process or the injection process." The Office Action then alleged that Akira provided the elements of the claims missing from Shimizu. Applicant respectfully traverses the obviousness rejection and submits that the cited references, either alone or in combination, do not disclose or suggest all the features of any of the presently pending claims.

Claim 1, upon which claim 2 is dependent, recites a method for controlling an injection molding machine including a heating cylinder and a screw disposed in the heating cylinder, and performing a plasticization/measuring process and an injecting process. The method includes defining a synchronization ratio S of a rotation speed of the screw to be 100% when the position of a flight thereof does not apparently move relative to a constant backward speed V of the screw. The method also includes moving the screw backwards at the constant backward speed V while rotating it after completion of the measuring process or the injecting process. A rotation speed R of the screw during the backward movement is given by multiplying the rotation speed R, which is expressed by the equation R = backward speed V/pitch P of the flight, by an arbitrary synchronization ratio Sx.

Claim 3, upon which claim 4 is dependent, recites a method for controlling an injection molding machine. The injection molding machine includes a heating cylinder, a screw disposed in the heating cylinder, a first driving source for driving the screw in an axial direction, and a second driving source for rotating the screw. The injection molding machine also includes position detecting means for detecting an axial position of the screw, rotation-speed detecting means for detecting the rotation speed of the screw, and a controller for controlling the first driving source and the second driving source dependent on the detecting signals transmitted from the position detecting means and the rotation-speed detecting means. The controller also performs a plasticization/measuring process and an injecting process. The method includes defining a synchronization ratio S of a rotation speed of the screw to be 100% when the position of a flight thereof does not apparently move relative to a constant backward speed V of the screw. The controller moves the screw backwards at the constant backward speed V while rotating it after the completion of the measuring process or the injecting process. A rotation speed R of the screw during the backward movement is given by multiplying the rotation speed R, which is expressed by the equation, R = backward speed V/pitch P of the flight, by an arbitrary synchronization ratio Sx.

Claim 9 is summarized previously.

Applicant submits that Shimizu, as discussed previously, does not disclose or suggest all the features of the pending claims for at least the reasons given above, and the additional reasons given below.

Akira relates to the control of metering speed of an injection molding machine. Akira describes that the retreating speed of a screw upon metering plasticized material is subject to direct feedback control in the case of injection molding. Rotation of screw 12 is driven by a screw driving motor 18 and molten resin is transferred by the rotation of the screw into the fore part of screw cylinder 10 while screw 12 is retreated by the pressure of the resin. A retreating speed detector 28 detects the actual retreating speed of the screw. The detected speed and an objective retreating speed are operated in a relational operator 32 to control the rotation of screw 12 in a direction to eliminate the difference between the speeds at operator 32.

Applicant submits that the cited references of Shimizu and Akira do not disclose or suggest all the features of any of the presently pending claims. For example, applicant submits that the cited references do not disclose or suggest "moving the screw backwards at the constant backward speed V while rotating it after completion of the measuring process or the injecting process," as recited in claim 1. Claim 3 recites "the controller moves the screw backwards at the constant backward speed V while rotating it after the completion of the measuring process or the injecting process." Claim 9 recites "linearly moving the screw backwards relative to the forward feeding direction of the molten resin at a constant backward speed and simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed, after completion of the plasticization process or the injecting process." Applicant respectfully

submits that the cited references do not disclose or suggest at least these features of the presently pending claims.

Applicant submits that the cited references do not disclose or suggest moving a screw backwards at a constant backward speed while rotating the screw after completion of the measuring or injecting process. As stated in the Office Action, Shimizu "does not show moving the screw backwards while rotating it after completion of the measuring process or the injection process." Further, applicant submits that Shimizu describes only servomotor 28 for the screw rotation is driven in its described process, as described in column 4, lines 31-39. Referring to Figure 3(b) of Shimizu, it is illustrated that servomotor 24 for injection is not driven during the backward operation of the screw. Thus, Shimizu does not disclose or suggest controlling the density distribution of the molten resin at the nose portion of the screw by reducing the high molten resin pressure caused by the measuring process or injecting process. Thus, Shimizu, for at least these reasons, does not disclose or suggest moving the screw backwards at the constant backward speed while rotating it after completion of the measuring process or injecting process.

With regard to claim 3, applicant submits that Shimizu also does not disclose or suggest a controller that moves the screw backwards at the constant backward speed V while rotating it after completion of the measuring process or the injecting process. Instead, Shimizu describes backward movement of screw 2, but not by a controller.

Thus, applicant submits that Shimizu does not disclose or suggest all the features of claim 3.

With regard to claim 9, applicant submits that Shimizu does not disclose or suggest linearly moving the screw backwards relative to the forward feeding direction of the molten resin at a constant backward speed. Thus, Shimizu, as discussed above, does not disclose or suggest controlling the density distribution of the molten resin in the heating cylinder, particularly at the nose portion, by reducing the high molten resin pressure caused by the plasticization process or the injecting process. Thus, applicant submits that Shimizu does not disclose or suggest at least this feature of claim 9.

Applicant also submits that Akira does not disclose or suggest the features of the claims missing from Shimizu. Applicant submits that Akira describes the retreat of screw 12 during the injection molding process. Akira does not disclose or suggest moving the screw backwards after the measuring process or the injecting process. Applicant also submits that Akira describes keeping the measuring time at a constant backward speed of the screw by the use of the rotation speed of the screw. Applicant submits that the timing of the moving of the screw, as claimed, is distinguishable from the teachings of Akira because the claimed feature enables suitable control of the density distribution of the molten resin in the heating cylinder. Thus, Akira does not disclose or suggest controlling the density distribution of the molten resin at the nose portion of the screw as the high molten resin pressure caused by the plasticization process or the injecting process

reduces. Thus, applicants submit that the combination of Shimizu and Akira does not disclose or suggest all the features of the pending claims.

With respect to claim 9, applicant further submits that Akira does not disclose or suggest linearly moving the screw backwards while rotating it in the forward feeding direction at the rotation speed corresponding to the constant backward speed after completion of the plasticization process or the injecting process. As the high molten resin pressure caused by the plasticization process or the injecting process reduces, examples of the present invention enable the density distribution of the molten resin in the heating cylinder to be sufficiently controlled. This feature may be evident particularly at the nose portion of the screw. In contrast, Akira does not disclose or suggest controlling the density distribution of the molten resin at the nose portion of the screw by reducing the high molten resin pressure caused by the plasticization process or the injecting process. Thus, Akira does not disclose or suggest linearly moving the screw backwards relative to the forward feeding direction of the molten resin at a constant backward speed and simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed, after completion of the plasticization process or the injecting process. Applicant submits that, for at least these reasons, Akira, either alone or in combination with Shimizu, does not disclose or suggest all the features of the pending claims.

Further, with regard to claims 1-4, the Office Action again took the position that the limitation of constant speed in the defining step is addressed as non-functional

descriptive material, as it pertains to computer-related inventions. As indicated in the previous Office Action, this limitation of the pending claims was not given any patentable weight. Applicant again submits that the recited limitation is a functional limitation and these features of the present claims are distinguishable from the cited references in terms of patentability because these limitations alter how steps are to be performed to achieve the claimed invention. Applicant submits that defining a synchronization ratio of a rotation speed of the screw to be 100% when the position of a flight does not move relative to a constant backwards speed of the screw alters how the steps recited in the claims are to be performed when practicing the invention. Thus, this limitation must be given patentable weight when determining patentability. See MPEP § 2106 VI.

For example, as recited in claim 1, the synchronization ratio is defined to be 100% when the position of a flight thereof does not apparently move relative to a constant backwards speed of a screw. A constant backwards speed is functional descriptive material as it does alter how the step is executed and must be considered and addressed in assessing patentability under 35 U.S.C. § 103(a). The Office Action again did not provide any aspects of the cited references that disclose or suggest these features, and applicants submit that no such disclosure or suggestion is, in fact, contained in the cited references. Applicant also notes that independent claims 1 and 3 recite a method for controlling and are not limited to computer-related inventions. Therefore all the limitations of these claims must be given patentable weight and considered in

determining patentability. Applicant again submits that at least these features are not disclosed or suggested by the cited references, either alone or in combination and that the Office Action was improper in not considering this limitation.

It is further submitted that each of the claims 1-12 recites subject matter that is neither disclosed nor suggested by the cited references, either alone or in combination. It is therefore respectfully requested that all of claims 1-12 be found allowable, and that this application be passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicant's undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,

William F. Nixon
Registration No. 44,262

Customer No. 32294
SQUIRE, SANDERS & DEMPSEY LLP
14TH Floor
8000 Towers Crescent Drive
Tysons Corner, Virginia 22182-2700
Telephone: 703-720-7800
Fax: 703-720-7802

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